

CLAIMS:

1. A photographic apparatus for taking images of an object for use in generating a three dimensional model of the object,
5 the photographic apparatus comprising an object placing unit for placing the object, an image capturing unit for capturing images of the object for use in generating the three dimensional model, and an illumination unit, the image capturing unit and the illumination unit being connectedly moveable relative to the object placing unit such that, in use, the object may be placed by the placing unit both in the field of view of the image capturing unit and in a position where the illumination unit is capable of providing illumination for the image capturing device to take silhouette
15 images of the object.
2. An apparatus as claimed in claim 1, wherein the image capturing unit and the illumination unit are arranged to be rotatably moved about an axis of rotation such that, whatever
20 angle the image capturing unit is at relative to the object, the object is positioned so that the illumination unit is capable of illuminating a side of the object opposite to a side thereof facing the image capturing device.
- 25 3. An apparatus as claimed in claim 2, wherein said placing unit includes a transparent table on which the object is placed, and said axis of rotation is closely located above the table.
- 30 4. An apparatus as claimed in any preceding claim, wherein the placing unit includes a rotatable turntable to enable the image capturing unit to be used to take images of the object at two or more different orientations.

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5. An apparatus as claimed in any preceding claim, wherein
the image capturing unit is used to take both silhouette and
textural images of the object, wherein the illumination unit
provides different illumination when textural images are taken
5 from when the silhouette images are taken.

6. An apparatus as claimed in claim 5, wherein the image
capturing unit takes two or more silhouette images of the
object at different orientations in a first period and two or
10 more textural images of the object at different orientations
in a second period, the first and second periods being non-
overlapping.

7. An apparatus as claimed in claim 5 or 6, further
15 comprising another illumination unit attached to said image
capturing unit for providing illumination for the image
capturing device to take textural images.

8. An apparatus as claimed in any preceding claim, wherein
20 the image capturing unit includes an image capturing device
and an optical device, and the optical device deflects an
optical axis extending from the object to the image capturing
device.

25 9. An apparatus as claimed in claim 8, wherein a relative
angle of the optical device and the image capturing device is
adjustable in order to move an image of the object towards the
centre of an optical view of the image capturing device.

30 10. An apparatus as claimed in claim 9, wherein the relative
angle the optical device and the image capturing device is
dependent on the angle of the image capturing device relative
to the object and/or on the size of said object.

11. An apparatus as claimed in any preceding claim, wherein
said illumination unit is mounted between a right illumination
arm and a left illumination arm, the image capturing unit is
5 mounted between a right camera arm and a left camera arm, said
right illumination arm and said right camera arm meet at a
right arm joint, and said left illumination arm and said left
camera arm meet at a left arm joint, and the apparatus further
comprising an arm drive, wherein said arm drive is arranged to
10 rotate said illumination and camera arms so as to rotate said
illumination unit and said image capturing unit about an axis
of rotation.

12. An apparatus as claimed in claim 11, wherein said placing
15 unit includes a transparent table on which the object is
placed, and, in use, the image capturing unit is settable to
at least four angles relative to the table.

13. An apparatus as claimed in claim 12, wherein, in use,
20 said image capturing unit takes a relatively large number of
images of said object when said image capturing unit is at a
lower angle relative to the table and takes a relatively small
number of images of said object when said image capturing unit
is at a greater angle relative to the table.

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14. An apparatus as claimed in any preceding claim, wherein,
in use, an exposure parameter of said image capturing unit is
set such that the resulting image is underexposed when said
image capturing unit is capturing silhouette data.

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15. A method of generating a three dimensional model of an
object, the method comprising the steps of:

placing the object using a placing unit such that the
object is in the field of view of an image capturing unit

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capturing an image of the object, wherein the image capturing unit and an illumination unit are connectedly moveable relative to the placed object;

5 taking a plurality of silhouette images of the object using the image capturing unit, with the illumination unit providing illumination for the image capturing device to take the silhouette images of the object; and using the plurality of images to generate a three dimensional model of the object.

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16. A method as claimed in claim 15, wherein the image capturing unit and the illumination unit are rotatably mounted about an axis of rotation such that, whatever angle the image capturing unit is at relative to the object, the object is 15 positioned between the image capturing unit and the illumination unit.

17. A method as claimed in claim 16, wherein said centre of rotation is closely located above a table on which the object 20 is placed.

18. A method as claimed in any one of claims 15 to 17, wherein the placing unit includes a turntable and is rotatable to enable the image capturing unit to be used to take images 25 of the object at two or more different orientations.

19. A method as claimed in any one of claims 15 to 18, wherein the image capturing unit includes an image capturing device and an optical device, and the optical device deflects 30 an optical axis extending from the object to the image capturing device in said step of taking a plurality of silhouette images.

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20. A method as claimed in claim 19, wherein the image capturing device and the optical device are relatively tiltable in order to move an image of the object towards the centre of an optical view of the image capturing device in 5 said step of taking a plurality of silhouette images.

21. A method as claimed in claim 20, wherein the magnitude and direction of the tilt is dependent on the angle of the image capturing device relative to the object and/or on the 10 size of said object.

22. A method as claimed in any one of claims 15 to 21, further comprising a step of performing a calibration subroutine to generate calibration data prior to the step of 15 placing said object, wherein said calibration subroutine comprises the steps of:

placing a calibration pattern in the field of view of the image capturing unit; and

20 taking a plurality of images of the calibration pattern using the image capturing unit.

23. A method as claimed in claim 22, when dependent on claim 20, wherein the images of the calibration pattern are taken from every orientation at which said silhouette images are to 25 be taken of an object to be modelled.

24. A method as claimed in any one of claims 15 to 23, further comprising a step of taking a plurality of textural images of the object to be modelled from different 30 orientations, wherein said illumination unit provides less illumination for the textural images than for the silhouette images.

25. A method as claimed in claim 24, wherein, a period for

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said step of taking the silhouette images and a period for said step of taking the textural are non-overlapping.

26. A method as claimed in claim 24 or claim 25, wherein
5 another illumination unit attached to said image capturing unit is provided to provide illumination for the image capturing device to take the textural images of the object.

27. A photographic apparatus for taking images of an object
10 for use in generating a three dimensional model of the object, the photographic apparatus comprising an object placing unit for placing the object and an image capturing unit for capturing images of the object for use in generating the three dimensional model, the image capturing unit including an image
15 capturing device and an optical device to deflect an optical axis extending from the object to the image capturing device, the apparatus being arranged such that, in use, the image capturing unit is arranged to be rotatably moved about an axis of rotation such that, whatever angle the image capturing unit
20 is at relative to the object the object may be placed by the object placing unit in the field of view of the image capturing device.

28. An apparatus as claimed in claim 27, wherein the optical
25 device deflects the optical axis by around 90 degrees.

29. An apparatus as claimed in claim 27 or claim 28, wherein a relative angle of the optical device and the image capturing device is adjustable in order to move an image of the object
30 towards the centre of an optical view of the image capturing device.

30. An apparatus as claimed in claim 29, wherein relative angle the optical device and the image capturing device is

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dependent on the angle of the image capturing device relative to the object and/or on the size of said object.

31. An apparatus as claimed in claim 29 or claim 30, wherein
5 the object placing unit includes a table on which the object is placed, and the angle of deflecting the optical axis is greater when the angle of image capturing device relative to the turntable is smaller.

10 32. An apparatus as claimed in any one of claims 27 to 31, further comprising an illumination unit being connectedly moveable with the image capturing unit relative to the object placing unit such that, in use, the object may be placed by the placing unit both in the field of view of the image 15 capturing unit and in a position where the illumination unit is capable of providing illumination for the image capturing device to take silhouette images of the object.

33. An apparatus as claimed in any one of claims 27 to 32, 20 wherein the placing unit includes a rotatable turntable to enable the image capturing unit to be used to take images of the object at two or more different orientations.

34. A system for generating three dimensional models of an 25 object, the system comprising an apparatus as claimed in any one of claims 1 to 14 or any one of claims 27 to 33, the system further comprising control means for obtaining image data and means for generating a three dimensional model from said images.

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35. A system as claimed in claim 34, wherein said control means includes a graphical user interface, a display for displaying information for an operator, and input means to enable an operator to communicate with the system.

36. A photographic apparatus for taking images of an object for use in generating a three dimensional model of the object, the photographic apparatus comprising an object placing unit 5 for placing the object and an image capturing unit for capturing images of the object for use in generating the three dimensional model, an optical focal length of the image capturing unit being variable in accordance with a size of the object placed by the placing unit in the field of view of the 10 image capturing unit.

37. An apparatus as claimed in claim 36, wherein the optical focal length is manually selectable depending on at least one of a width, a depth, and a height of the object.

15 38. An apparatus as claimed in claim 38, further comprising a display for showing a user interface through which the optical focal length is selected.

20 39. An apparatus as claimed in any one of claims 36 to 38, wherein a photographing position or orientation of the image capturing unit is variable in accordance with the size of the object.

25 40. An apparatus as claimed in claim 39, wherein the image capturing unit comprises an image capturing device and an optical device for deflecting an optical axis extending from the object to the image capturing device, a relative angle of the image capturing device and the optical device is varied in 30 accordance with the size of the object for varying the photographic position or orientation.

41. An apparatus as claimed as claim 40, wherein relative angle the optical device and the image capturing device is

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dependent on the angle of the image capturing device relative to the object and on the size of said object.

42. An apparatus as claimed as any one of claims 36 to 41,
5 wherein the image capturing unit is calibrated for each optical focal length.